Uintah Basin Air Quality Research project

Background Information About Uintah Basin Air Quality

- Ozone negatively impacts respiratory health, especially for those with lung diseases. Because of its impacts on health, EPA regulates ozone in ambient air.
- Ozone concentrations have exceeded the EPA standard of 70 parts-per-billion (calculated as the daily maximum 8-hour average) during some winters in the Uintah Basin.
- The number of ozone exceedance days and concentrations of ozone that occur each year are closely tied to meteorology. Years with persistent snow cover and high barometric pressure tend to have more days with strong winter inversions and high ozone. During inversion episodes, ozone concentrations tend to be higher at lower elevations where inversion conditions are stronger and last longer. For example, during an inversion episode in February 2017, Ouray (4803 ft. above sea level) registered 10 exceedance days and up to 111 ppb of ozone, while Vernal (5268 ft. above sea level) had no exceedance days and a maximum of 69 ppb.
- Ozone is formed from chemical reactions involving pollutants emitted to the atmosphere. Winter inversions are extremely effective at trapping locally-emitted pollution within the Uintah Basin, making external sources of ozone and its precursors less important. The Basin has about 10,000 oil and gas wells, and the oil and gas industry is the largest local contributor of ozone-forming emissions.
- The Uintah Basin's oil and gas industry does not emit ozone-forming pollutants more heavily than the average of other oil and gas producing basins in the United States. Instead, the Basin's uniquely strong and long wintertime inversions allow an average level of emitted pollution to lead to high levels of ozone. In the absence of winter inversions, ozone concentrations in the Basin are similar to those in other rural, high-elevation locations around the western United States.
- Portions of the Uintah Basin are very likely to be declared in non-attainment of the EPA ozone standard, leading to increased regulation and emissions controls. EPA will make a final designation of the Basin's non-attainment status in October 2017.
- Exceedances of the EPA standard for particulate matter (i.e., $PM_{2.5}$) have occasionally been observed in the Uintah Basin during winter inversions. Particulate matter exceedances are infrequent enough, however, that the region is not in danger of becoming a non-attainment area for particulate matter.

Purpose of the Uintah Basin Air Quality Research Project

- Wintertime ozone in rural areas like the Uintah Basin has only been known to science since 2006, and the Uintah Basin is one of only two areas in the world where wintertime ozone is known to occur (the other is Wyoming's Upper Green River Basin). Because of this, many aspects of the meteorology, chemistry, and emissions that allow ozone to form during winter are still poorly understood.

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- Federal and state agencies are required by law to promulgate regulations that reduce ozone-forming emissions in the Uintah Basin. These regulations will mostly target the local oil and gas industry, which is the basis for the majority of the Basin's economy.
- Scientific research to better elucidate the causes and characteristics of winter ozone formation can help industry and regulators craft emissions reductions that maximize effectiveness and minimize costs to the local industry and economy.
- Recognizing this, in 2016 the Utah Legislature tasked Utah State University's Bingham Research Center with conducting research to improve understanding of winter ozone in the Uintah Basin. This research is to include the following:
    - Collection and analysis of ambient air measurements of meteorology and chemistry,
    - Improvement of air quality computer models that are used by industry and regulators to develop emissions control strategies, and
    - Characterization of emission sources through measurements and analysis

Current Research Emphases

- We monitor air quality and meteorological phenomena at several stations around the Uintah Basin during winter months to assess spatial and temporal changes in ozone and related pollutants, including the impact of changes in oil and gas production levels and practices on air quality.
- Computer models used to develop pollution control strategies were not designed for wintertime inversion conditions, and they fail to adequately represent many characteristics of inversion episodes. We are developing methods to assimilate measurement data into these models so they are better able to reproduce the fine-scale temperature, wind, and cloud conditions of inversion episodes, which, in turn, allows for more accurate modeling of ozone and its precursors.
- Estimates of the amount and type of pollutants emitted from oil and gas exploration and production activities are very uncertain. Improving these estimates will allow for more targeted, effective emissions reductions, which will minimize costs to industry. We are working to improve emissions estimates from many sources. Some of these projects include:
    - Measurement and analysis of organic compound emissions from produced water ponds, which have never been comprehensively characterized in the Uintah Basin or elsewhere.
    - Measurement of emissions from liquid storage tanks that hold oil or condensate on well pads. These account for about 1/3 of all organic compound emissions from the industry, and reducing their emissions can be, in many cases, inexpensive.
    - Incorporation of a new emissions inventory developed by the Utah Division of Air Quality and others into our computer modeling framework for evaluation and analysis.
- We are exploring interactions that occur between the snowpack and the atmosphere. Snowpack can act as a reservoir for organic compounds involved in ozone formation, taking up organics sometimes, and releasing them at other times. Snow may also convert organics into other compounds that are more reactive and more able to produce ozone. This could be a very large source of ozone-forming emissions, and understanding it better will help us understand how to model winter ozone and how emissions controls will impact ozone production.
- We are developing methods to accurately forecast high ozone days so industry and the public can plan ahead to reduce emissions and exposure to pollution.

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